

Chapter 5: Landslides

5 Latah County Conditions

Latah County is characterized by rolling basalt plateaus dissected by deep canyons. The plateaus are mantled with deposits of loess that are tens of feet thick in places. The deep canyons draining toward the Potlatch River cut through the basalt flows that underlie Latah County. These flows are interbedded with loose, unstable sedimentary layers that are exposed in the deeply incised canyons. The expose of this unconsolidated sedimentary layer increases landslide potential wherever these deposits are present on steep slopes. Weathering and climatic events lead to landslide activity, with the scale of the event largely dependent on the environmental conditions leading up to the event. Highway 3, 99, and structures along Potlatch River are most likely to be affected by landslide activity due to the steep walls of the Potlatch Canyon. Roads and structures in any area within the county where logging roads or other roads have cut through steep basalt fields are also at increased risk.

5.1 *Landslide Hazard Profile*

Landslide is a general term for a wide variety of down slope movements of earth materials that result in the perceptible downward and outward movement of soil, rock, and vegetation under the influence of gravity. The materials may move by falling, toppling, sliding, spreading, or flowing. Some landslides are rapid, occurring in seconds, whereas others may take hours, weeks, or even longer to develop. Although landslides usually occur on steep slopes, they also can occur in areas of low relief. Landslides can occur as ground failure of river bluffs, cut and-fill failures that may accompany highway and building excavations, collapse of mine-waste piles, and slope failures associated with quarries and open-pit mines.

The primary factors that increase landslide risk are slope and certain soil characteristics. In general, the potential for landslide occurrence intensifies as slope increases on all soil types and across a wide range of geological formations.

Soil factors that increase the potential for landslide are soils developed from parent materials high in schist and granite, and soils that are less permeable containing a resistive or hardpan layer. These soils tend to exhibit higher landslide potential under saturated conditions than do well drained soils. To identify the high-risk soils in Latah County, the NRCS State Soils Geographic Database (STATSGO) layer was used to identify the location and characteristics of all soils in the County. The specific characteristics of each major soil type within the County was reviewed. Soils with very low permeability that characteristically have developed a hardpan layer or have developed from schist and granite parent material were selected as soils with potentially high landslide risk potential. High-risk soils magnify the effect slope has on landslide potential. Soils identified as having high potential landslide risk are further identified only in areas with slopes between 14° and 30° (25-60%). It is these areas that traditionally exhibit the highest landslide risk due to soil characteristics within a given landscape.

To portray areas of probable landslide risk due to slope related factors, slope models were used to identify areas of low, moderate and high risk. This analysis identified the low risk areas as slopes in the range of 20°-25° (36-46%), moderate as 26°-30° (48-60%) and high risk as slopes in the range of 31°-60° (60-173%). Slopes that exceeded 60° (173%) were considered low risk due to the fact that sliding most likely had already occurred relieving the area of the potential energy needed for a landslide. From the coverage created by these two methods it is possible to depict areas of risk and their proximity to development and human activity. With additional

field reconnaissance the areas of high risk were further defined by overlaying additional data points identifying actual slide locations, thus improving the resolution by specifically identifying the highest risk areas. This method of analysis is similar to a method developed by the Clearwater National Forest in north central Idaho (McClelland *et al.* 1997).

Landslide may occur on slopes steepened by man during construction, or on natural ground never disturbed. However, most slides occur in areas that have had sliding in the past. All landslides are initiated by factors such as weaknesses in the rock and soil, earthquake activity, the occurrence of heavy snow or rainfall, or construction activity that changes a critical factor involved with maintaining stability of the soil or geology of the area. A prime example of this includes previously stable slopes where home construction utilizing independent septic systems are added. The increased moisture in the ground, when coupled with an impermeable layer below the septic systems has led to surface soil movements and mass wasting.

Landslides can be triggered by natural changes in the environment or by human activities. Inherent weaknesses in the rock or soil often combine with one or more triggering events, such as heavy rain, snowmelt, or changes in ground water level. Late spring-early summer is slide season, particularly after days and weeks of greater than normal precipitation. Long-term climate change may result in an increase in precipitation and ground saturation and a rise in ground-water level, reducing the shear strength and increasing the weight of the soil.

Stream and riverbank erosion, road building or other excavation can remove the toe or lateral slope and exacerbate landslides. Seismic or volcanic activity often triggers landslides as well. Urban and rural living with excavations, roads, drainage ways, landscape watering, logging, and agricultural irrigation may also disturb the solidity of landforms, triggering landslides. In general, any land use changes that affects drainage patterns or that increase erosion or change ground-water levels can augment the potential for landslide activity.

Landslides are a recurrent menace to waterways and highways and a threat to homes, schools, businesses, and other facilities. The unimpeded movement over roads—whether for commerce, public utilities, school, emergencies, police, recreation, or tourism—is essential to a normally functioning of Latah County. The steep walls of the Potlatch River drainage pose special problems to Highway 3, and 99 the major intercommunity travel route to Kendrick and Juliaetta. The disruption and dislocation of this or any other routes in the breaklands caused by landslides can quickly jeopardize travel and vital services.

Landslide risks in and around Latah County were evaluated and are presented in a number of Figures in this chapter. An analysis of this data reveals that approximately 2% of the area in Latah County is in the Extreme risk category, 3% is in the High risk category, 9% is in the Moderate risk category, with the remaining 86% at little to no risk to landslides from slope and geology factors (Table 5.1).

Table 5.1. Landslide Risk Due to Slopes and Geology in Latah County.





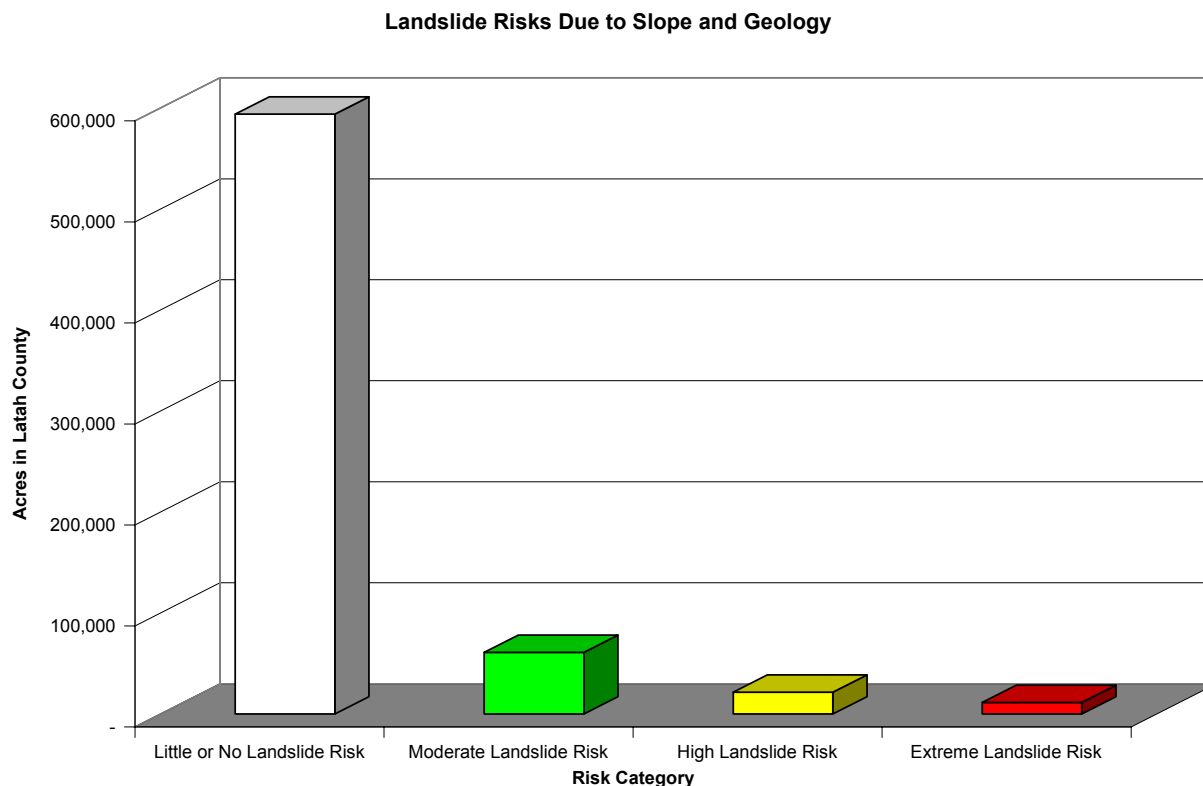
Risk Due to Slopes and Geology		Acres	Percent
	Little or No Landslide Risk	593,859.37	86%
	Moderate Landslide Risk	61,057.67	9%
	High Landslide Risk	21,716.87	3%
	Extreme Landslide Risk	11,627.55	2%

Figure 5.1. Landslide Risks in Latah County: Geology and Slope Factors.



Soil factors, as described above account for additional risks, literally on-top-of the slope and geological factors detailed in Table 5.1 and Figure 5.1. There are approximately 46,701 acres of soils in this high risk soils category. In order to evaluate the juxtaposition of these soils to the areas at risk from slopes and geology, those areas underlying the areas determined to be at risk due to soil conditions were evaluated, separate from the rest of the County. This analysis reveals that in those areas with high soil risk factors, approximately 62% of that area is at little to no risk due to slope and geological factors, 30% is at Moderate landslide risk, 8% is at High landslide risk, and no area is at Extreme landslide risk (Table 5.2). While all areas specified at risk from either assessment should be given consideration for planning, zoning, and determining risks to human development and use, it is the lands that show risk through both assessment strategies that should receive additional attention and mitigation measures, especially where developments already exist.

Table 5.2. Landslide Risk Due to Slopes and Geology that are also at risk due to soil factors in Latah County.





Risk Due to Slopes and Geology		Acres	Percent
	Little or No Landslide Risk	28,955	62%
	Moderate Landslide Risk	14,068	30%
	High Landslide Risk	3,679	8%
	Extreme Landslide Risk	-	0%

Figure 5.2. Landslide Risks in Latah County: Geology, Slope, and Soil Factors.

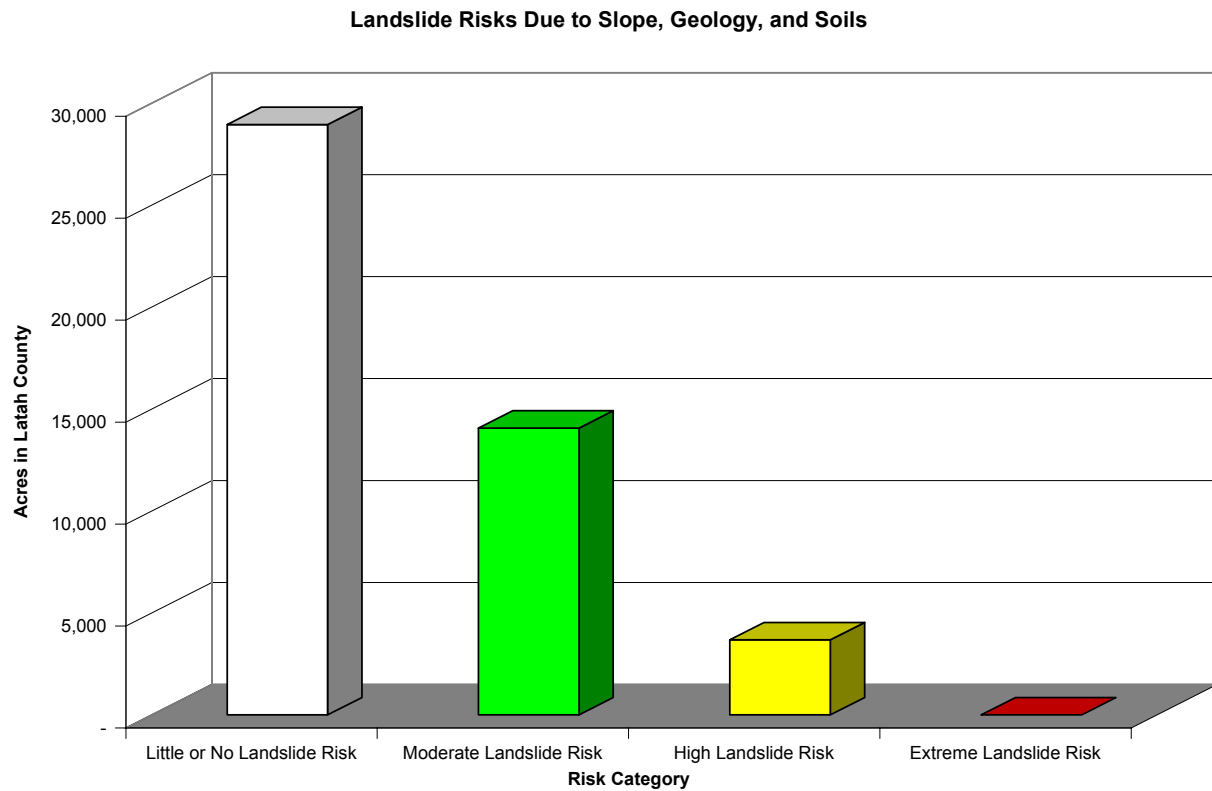


Figure 5.3. Landslide Prone Landscapes of Latah County; Slope and Geologic Factors.

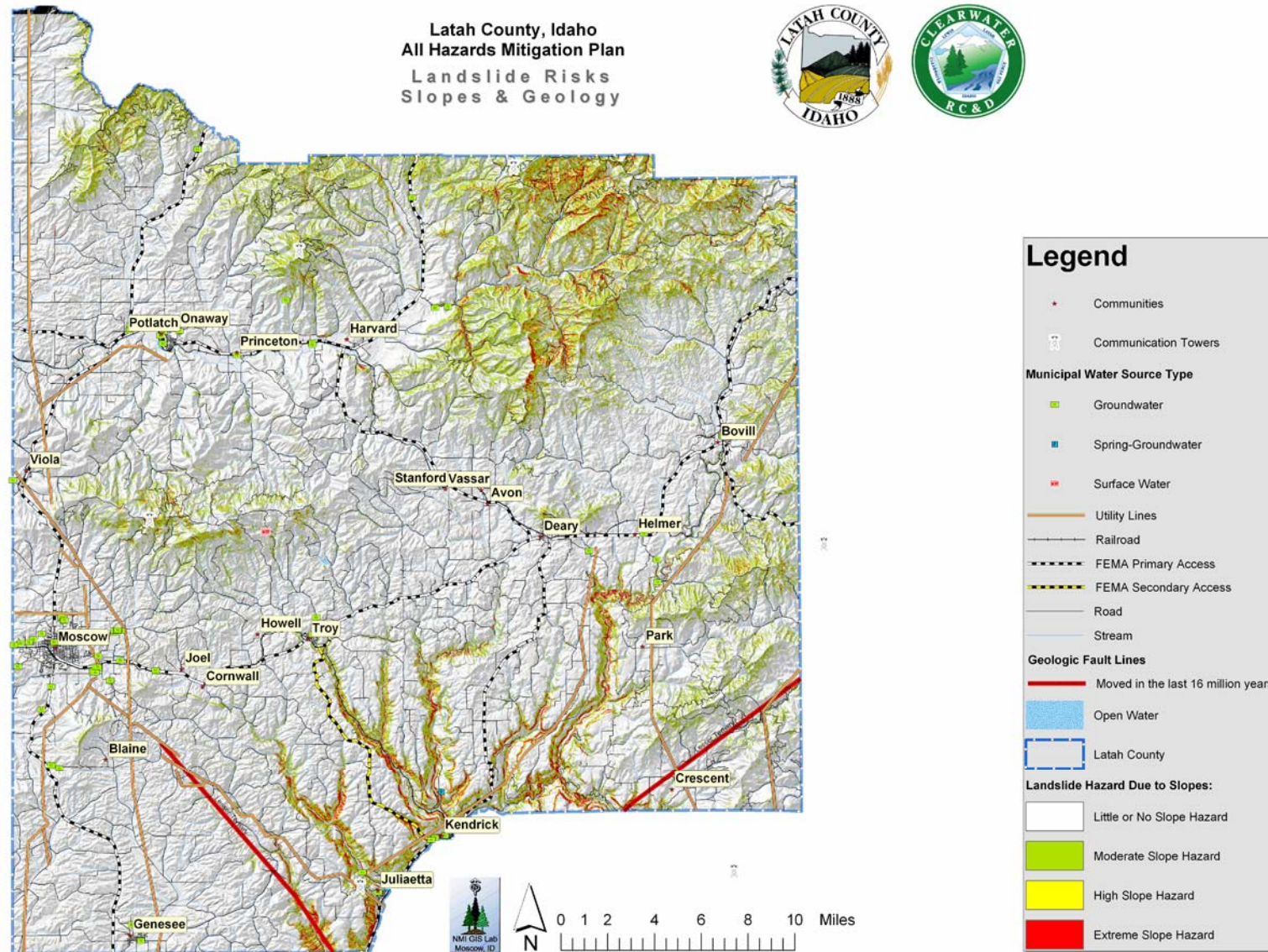
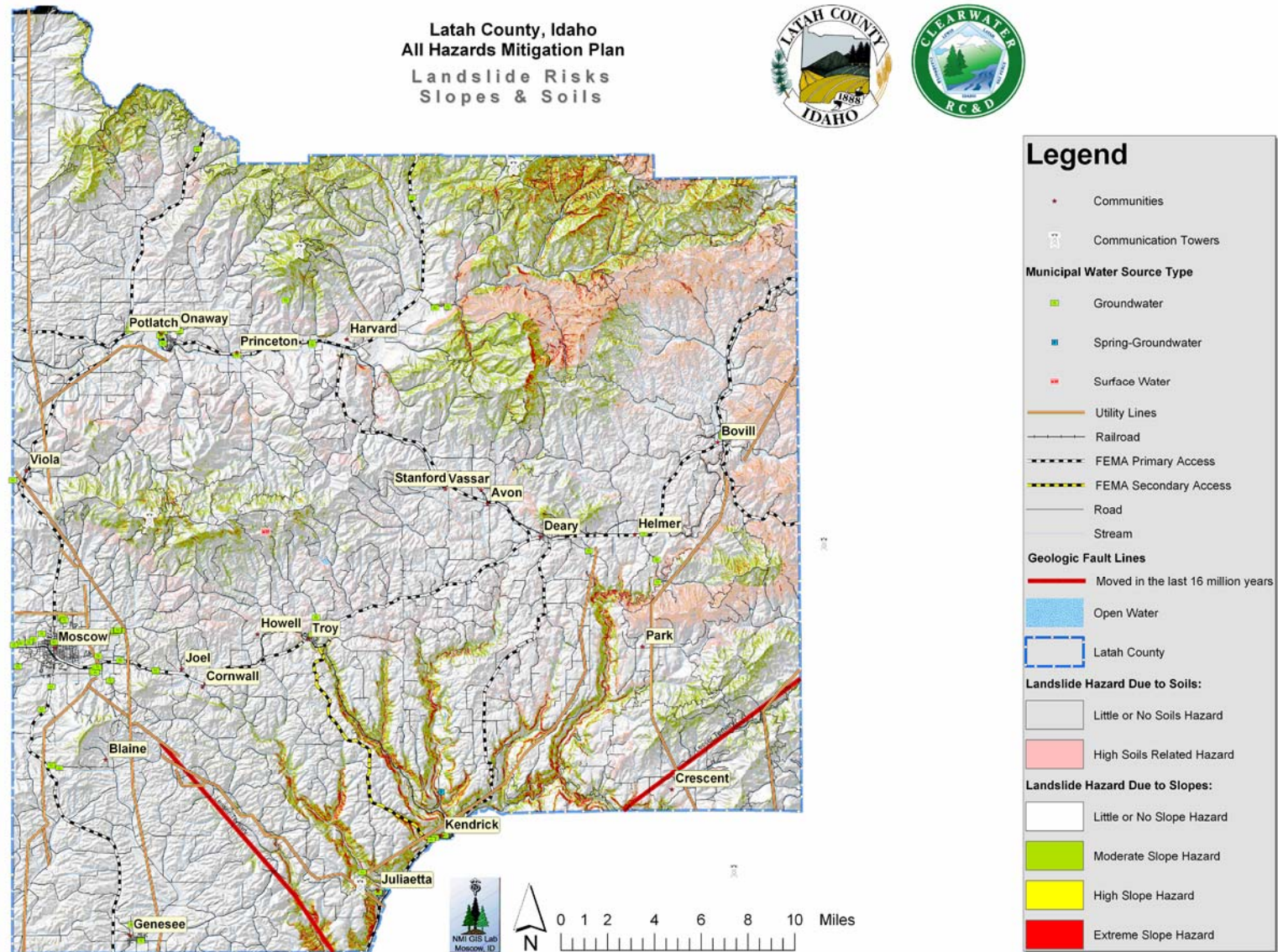


Figure 5.4. Landslide Prone Landscapes of Latah County; Slope, Geologic, and Soil Factors.



5.2 *Landslide Prone Landscapes*

Many areas have specific landslide concerns. Areas that are generally prone to landslides are:

- On existing landslides, old or recent
- On or at the base or top of slopes
- In or at the base of minor drainage hollows
- At the base or top of an old fill slope
- At the base or top of a steep cut slope

There are many homes, roads and other resources at risk in Latah County because of their juxtaposition to one or more of these characteristics. Individual assessments of landslide-prone areas that would cause disruption in Latah County are detailed in subsequent sections of this plan.

5.3 *General Landslide Hazards Mitigation Strategies*

A number of techniques and practices are available to reduce and cope with losses from landslide hazards. Careful land development can reduce losses by avoiding the hazards or by reducing the damage potential. Following a number of approaches used individually or in combination to reduce or eliminate losses can reduce landslide risk.

5.3.1 Establish a Countywide landslide hazard identification program

Document all landslides, bank failures, “washouts”, and manmade embankment failures. Each failure should be located on a map with notations about time of failure, repair (if made), and descriptions of the damaged area. This could become a County directive to the road and bridge crews.

5.3.2 Restricting development in Landslide Prone Landscapes

Land-use planning is one of the most effective and economical ways to reduce landslide losses by avoiding the hazard and minimizing the risk. This is accomplished by removing or converting existing development or discouraging or regulating new development in unstable areas. Buildings should be located away from known landslides, debris flows, steep slopes, streams and rivers, intermittent-stream channels, and the mouths of mountain channels. In the State of Idaho, restrictions on land use generally are imposed and enforced by local governments by land-use zoning districts and regulations.

5.3.3 Standardizing codes for excavation, construction, and grading

Excavation, construction, and grading codes have been developed for construction in landslide-prone areas; however, there is no nationwide standardization. Instead, State and local government agencies apply design and construction criteria that fit their specific needs. The Federal Government has developed codes for use on Federal projects. Federal standards for excavation and grading often are used by other organizations in both the public and private sectors.

5.3.4 Protecting existing development

Control of surface-water and ground water drainage is the most widely used and generally the most successful slope-stabilization method. Stability of a slope can be increased by removing all

or part of a landslide mass or by adding earth buttresses placed at the toes of potential slope failures. Restraining walls, piles, caissons, or rock anchors are commonly used to prevent or control slope movement. In most cases, combinations of these measures are used.

5.3.5 Post warnings of potentially hazardous areas and educate the public about areas to avoid

Such areas may include (a) existing / old landslides, (b) on or at the base of a slope, (c) in or at the base of a minor drainage hollow, (d) at the base or top of an old fill or steep cut slope, and (e) on developed hillsides where leach field septic systems are used. In addition to identifying these at-risk landscapes, it will also serve to begin an educational dialog with landowners in Latah County, enlightening residents and visitors to the risks associated with landslides.

5.3.6 Utilizing monitoring and warning systems

Monitoring and warning systems are utilized to protect lives and property, not to prevent landslides. However, these systems often provide warning of slope movement in time to allow the construction of physical measures that will reduce the immediate or long-term hazard. Site-specific monitoring techniques include field observation and the use of various ground motion instruments, trip wires, radar, laser beams, and vibration meters. Data from these devices can be sent via telemetry for real-time warning. Development of regional real-time landslide warning systems is one of the more significant areas of landslide research (Fragaszy 2002, USGS 2004).

5.3.7 Public Education

Residents can increase their personal awareness by becoming familiar with the land around the home and community. People can learn whether landslides or debris flows have occurred in the area by contacting local officials, state geological surveys or departments of natural resources, USGS maps, and university departments of geology. Slopes where landslides or debris flows have occurred in the past are likely to experience them in the future.

Educate the public about telltale signs that a landslide is imminent so that personal safety measures may be taken. Some of these signs include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before.
- New cracks or unusual bulges in the ground, street pavements or sidewalks.
- Soil moving away from foundations, and ancillary structures such as deck-sand patios tilting and/or moving relative to the house.
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb.
- Broken water lines and other underground utilities.
- Leaning telephone poles, trees, retaining walls or fences.
- Sunken or dropped-down roadbeds.
- Rapid increase in a stream or creek water levels, possibly accompanied by increased turbidity (soil content).
- Sudden decrease in creek water levels even though rain is still falling or just recently stopped.

Residents or county representatives who live and work in landslide prone areas should follow these recommendations prior to a storm event:

- Watch the patterns of storm-water drainage on slopes and note places where runoff water converges, increasing flow over soil-covered slopes. Watch the hillsides around your home and community for any signs of land movement, such as small landslides or debris flows or progressively tilting trees.
- Develop emergency response and evacuation plans for individual communities and for travel routes. Individual homeowners and business owners should be encouraged to develop their own evacuation plan.

(USGS 2004)

5.4 Individual Community Assessments

5.4.1 Kendrick/Juliaetta

Kendrick and Juliaetta are located in the canyon of the Potlatch River. The Potlatch River has cut deep canyons into the Palouse Prairie and the basalt flows that underlie much of the area. Large areas of landslide deposits dominate the geology around Kendrick and Juliaetta, the result of the movement of sedimentary materials interbedded with the basalt flows. Landslide deposits occur where major sedimentary interbeds are exposed along the steep valley sides.

5.4.1.1 Landslide Potential

The Kendrick and Juliaetta area has been an area of active landslide activity in the geologic past as well as in the present. The factors that lead to slope instability have been present in the area since ancient times. Although recent years have not seen the same level of activity that was typical in ancient times, these characteristics remain. Many of the slopes and hillsides along the Potlatch River and in the vicinity of Kendrick and Juliaetta are comprised by material deposited by past landslides. Location of landslide deposits in canyons is controlled by the presence of sedimentary interbeds, the hydrologic regime, and the occurrence of basalt overlying clay-rich weathered basement rocks. The largest landslides occur where canyon cutting has exposed landslide-prone sediments to steep topography. Today, initiation and reactivation of landslides is closely tied to unusual climatic events and land-use changes. Even small landslide activity on the upper parts of canyon slopes can transform into high-energy debris flows that endanger roads, buildings, and people below. Landslide debris is highly unstable when modified through natural variations in precipitation, artificial cuts, fills, and changes to surface drainage and ground water (Weisz et al 2003).

Past landslide activities include one that occurred two years ago on the McGary Road and one just east of Juliaetta north of Highway 3. The McGary Road Slide was due to the configuration of the road cut along the mountain. The landslide that occurred east of Juliaetta was the result of a gully washer that ended up taking out a mobile home in the area.

The Idaho Geological Survey has aggressively been mapping surficial geologic features along the Potlatch River. These maps provide valuable information for planning of private and public land planning by identifying areas of unstable geologic formations. This work indicates that there are numerous visible landslide blocks on many of the steep slopes above the community of Kendrick and Juliaetta and in the Potlatch River Drainage. The presence of these landslide blocks is a strong indicator of possible landslide activity in the future.

Poorly sorted material deposited during debris flow events is also present in alluvial fans in the Kendrick and Juliaetta area. These deposits are at the mouths of steep chutes and small canyons along the breaks of the Potlatch River drainage. The presence of this material indicates the historic occurrence of high-energy, short duration floods and debris flows in these chutes in response to severe climatic conditions, such as thunderstorms and rain-on-snow events. During these events, material present in the sedimentary layers was washed down the steep drainages and deposited at the mouth of the chutes, forming alluvial fans of varying sizes. These events are historically infrequent, with recurrence cycles on the order of years to decades. However, these events can result in significant damage to buildings and infrastructure, disrupt travel, reduce water quality and jeopardize safety.

5.4.1.2 Community Risk Assessment

The communities of Kendrick and Juliaetta are at moderate risk to landslide activity. Homes and travel routes that have been constructed at the mouths of steep chutes and through alluvial deposits that are at an increased risk of being affected by landslide activity. These historic deposits are a strong indicator of debris flows in the future. Furthermore, these deposits tend to be unstable and somewhat prone to movement. The following is a list of areas that are built in alluvial fans:

- The homes and infrastructure north and south of Highway 3.
- Homes and infrastructure along Highway 99.
- Homes located up Cedar Ridge Road.
- Homes located along McGary Grade (Nez Perce County).

Debris flow activity and the resulting alluvial sediment deposition is associated with soil saturation and precipitation events. As mentioned, landslide events are generally associated with large precipitation events. The areas noted above are in areas with landslide characteristics. The probability of these events occurring during normal weather conditions is quite low. However during large precipitation events residents and county representatives should monitor these areas for landslide activity.

The potential for debris flows and landslides would dramatically escalate in the event of a large wildland fire event that denudes the steep canyon slopes of vegetative cover. The loss of the vegetative cover reduces slope stability by removing much of the organic matter that helps absorb and intercept precipitation and anchor the fragile soil to the canyon walls. For a more complete discussion of fire-induced debris flows, refer to Wildland Urban Interface Fire Mitigation Plan.

5.4.1.3 Mitigation Activities

See County-wide Mitigation Activities above.

5.5 All Other Latah County Communities

Includes Moscow, Potlatch, Troy, Deary, and Bovill.

5.5.1 Landslide Potential

The Communities of Moscow, Potlatch, Troy, Deary, and Bovill are located on the Palouse Prairie in areas of low relief. The Palouse Prairie region is known for its deep, fertile loess soils

and crop production capacity. Soils throughout this are many feet deep. Due to the gentle topography of the area, landslide potential is quite low. However, landslide activity is possible wherever roads or other excavations have been constructed across the toe of steep hill slopes. Landslide events under these soils and topographic conditions would be associated with soil saturation and the loss of cohesion between soil particles. Soils with an underlying hardpan are elevated risk due to the presence of a consistent bed surface for slope failure. Once soils become saturated, soil water accumulates at the hardpan, lubricating and reducing friction between particles. This surface can then act as a sliding surface, potentially leading to slope failures.

5.5.2 Community Risk Assessment

All the communities on the Palouse Prairie are at low risk to landslide activity. The gentle topography of the Palouse Prairie reduces the probability of landslide occurrence. Although slope failures are possible, these would likely be isolated areas where excavation or road building has weakened slope stability.

5.6 Fire Related Debris Flows

Wildland fires are inevitable in the western United States where burnable vegetation exists. Expansion of human development into forested areas has created a situation where wildfires can adversely affect lives and property, as can the flooding and landslides that potentially occur in the aftermath of the fires. Post-fire landslide hazards include fast-moving, highly destructive debris flows that can occur in the years immediately after wildfires in response to high intensity rainfall events, and those flows that are generated over longer time periods accompanied by root decay and loss of soil strength. Post-fire debris flows are particularly hazardous because they can occur with little warning, can exert great impulsive loads on objects in their paths, can strip vegetation, block drainage ways, damage structures, and endanger human life. Wildfires could potentially result in the destabilization of pre-existing deep-seated landslides over long time periods.

5.6.1 Conditions for fire-related debris-flow occurrence

In a recent study of the erosion response of recently burned basins in the intermountain west, the USGS found that not all basins produce debris flows; most burned watersheds respond to even heavy rainfall events by flooding. However, those watersheds that do produce destructive debris flows can be readily identified by a combination of geologic, topographic, and rainfall characteristics. The factors that best determine the probability of debris-flow occurrence are:

- The percent of area burned in each basin at both high and moderate severities,
- The average storm rainfall intensity,
- The measure of sorting of the grain-size distribution of the burned soil,
- The percent of soil organic matter (by weight),
- The soil permeability,
- The soil drainage, and
- The percent of the basin with slopes great than or equal to 30%.

The results from post-fire erosion rates show that the majority of post-fire erosion results from summer thunderstorms rather than frontal storms or snowmelt (MacDonald *et al.* 2004).

Thunderstorm events producing 0.25 inches of precipitation an hour have been used as a threshold for flash flooding in severely burned areas of Western Montana.

5.6.2 General Mitigation Activities

There are a number of mitigation activities that can be implemented following large wildland fires in order to help rehabilitate the site. Rehabilitation efforts help speed the ecological recovery of the burned area while reducing the potential for rapid runoff, rilling, gullying, and development of destructive debris flows. These efforts also help reduce the loss of soil productivity and water quality, while reducing the threat to human life and property. In the event of large-scale fire events, a complete Burned Area Emergency Recovery (BAER) plan should be completed in order to address the unique features of the burn. The following is a partial list of components that would likely be included in a BAER plan.

- Directional tree felling, and contour log terracing along drainages and slopes with high burn severity in order to reduce overland and in stream channel flow. This can help reduce the amount of runoff and potential to initiate rilling and downstream mud and debris flows.
- Aerially seed moderate to high burn areas to provide short-and long-term vegetative cover to reduce water yield and sedimentation.
- Apply straw mulch to high severity burn areas where soils are well drained, occurring on gentle slopes and are protected from the wind. Mulch will slow runoff and help to prevent erosion. Topsoil will be protected and soil moisture will be maintained to promote biological activity in the soil.
- Install straw bale check dams in steep drainages in order to trap sediment.
- Place flood hazard warning signs in areas prone to flash-flooding.
- Install straw wattles in a checkerboard fashion along the contour of hillsides. The wattles serve as soil erosion and runoff control measure on steep slopes with a high degree of water repellency. Waddles can help stabilize the slope, minimize soil erosion and capture sediment.
- Clear, reinforce, and if needed, replace undersized culverts and stream crossings within the burn area to prevent washout along roads. Since water yield will be dramatically higher in the post-burn condition, drainage systems need to be restructured in order to accommodate the increase in flow.